Open

Original Article

Forensic practitioners' expectations and moral views regarding neurobiological interventions in offenders with mental disorders

Jona Specker[a,*], Farah Focquaert[b], Sigrid Sterckx[b] and Maartje H. N. Schermer[a]

[a]Department of Medical Ethics and Philosophy of Medicine, Erasmus Medical Center, PO Box 2040, 3000 CA Rotterdam, The Netherlands.
E-mail: J.Specker@ErasmusMC.nl

[b]Department of Philosophy & Moral Sciences, Bioethics Institute Ghent, Ghent University, Ghent, Belgium.

*Corresponding author.

Abstract Neurobiological and behavioural genetic research gives rise to speculations about potential biomedical interventions to prevent, contain, or treat violent and antisocial behaviour. These developments have stirred considerable ethical debate on the prospects, threats, and limitations of integrating neurobiological and behavioural genetic interventions in forensic psychiatric practices, yet little is known about how forensic practitioners perceive these potential interventions. We conducted a qualitative study to examine (i) the extent to which forensic practitioners expect that effective biomedical interventions will be developed and integrated in their daily work practice and (ii) their normative views concerning those potential biomedically informed interventions. We focused on potential biomedical possibilities to lower aggression, the possible usage of neuroimaging in assessing legal responsibility, and the potential use of biomarkers in assessing risk for future violent and antisocial behaviour. Forensic practitioners expect novel biomedical interventions to be developed and display a general openness towards them. At the same time, they express concern that the integration of neurobiological and behavioural genetic elements in explanatory models of violence and antisocial behaviour may lead to misinterpretations, especially when implemented in the forensic field.
BioSocieties (2017). doi:10.1057/s41292-017-0069-9

Keywords: antisocial behaviour; early prevention; legal responsibility; neuroscience; forensic mental health

Introduction

Scientific developments in neurobiology and behavioural genetics give rise to speculations about potential biomedical interventions to prevent, contain, or treat violent and antisocial behaviour (Eichelberger and Barnes, 2015; Fozdar, 2016; Glenn and Raine, 2014; van der Gronde *et al*, 2014; Lee, 2015; de Ridder *et al*, 2009; Rocque *et al*, 2012). These potential developments have stirred considerable ethical debate on the prospects, threats, and limitations of integrating neurobiological and behavioural genetic interventions in forensic psychiatric practices (Chhangur *et al*, 2015; Horstkötter, 2015; Hübner and White, 2016; Munthe and Radovic, 2015; Pustilnik, 2009; Rose, 2000; Rose and Abi-Rached, 2013).

In this study, we intend to broaden the ethical debate by asking how practitioners in forensic mental health contexts (both forensic psychiatrists and clinical psychologists and therapists) view these potential interventions. Do they expect that effective biomedical interventions aimed at preventing, containing, and treating violent and antisocial behaviour will be developed? How do they normatively view the potential integration of such interventions within current treatment practices? For the present study, we interviewed forensic practitioners about their expectations as well as moral views regarding potential applications of current neurobiological and behavioural genetic research aiming to understand (and possibly help prevent, contain, or treat) violent and antisocial behaviour.

An earlier study asked people who are professionally engaged in the criminal justice system and who work with young people and families judged to be 'at risk' of criminal or antisocial behaviour about their views on the causes of violent and antisocial behaviour, their response to the idea of a genetic susceptibility to aggressive behaviour, and possible implications for their own work (Pieri and Levitt, 2008). Other studies explored the views of juveniles in juvenile justice institutions on biological explanations of antisocial behaviour (Horstkötter *et al*, 2014b) and the views of parents and (non-forensic) healthcare professionals (genetic professionals and paediatricians) on genetic tests for violent behaviour (Campbell and Ross, 2004). To the best of our knowledge, this is the first interview study to probe the normative views of forensic mental health practitioners concerning potential future biomedical interventions for forensic patients and offenders with mental health issues.

We first asked forensic practitioners, with reference to their role in treating forensic patients and offenders with mental health issues, about their expectations regarding potential future biomedical possibilities to lower aggression. Current research on the neurobiology and (epi)genetics of aggression may inform new treatments for pathological, maladaptive, or antisocial aggressive behaviour (Asherson and Cormand, 2016). Aggressive behaviours are often partially refractory to medication (Gurnani *et al*, 2016; Raine, 2013; Temel *et al*, 2016). Research on novel medications and neuro-stimulation may provide new ways to deal with aggressive behaviours. Non-invasive interventions may involve biofeedback, transcranial magnetic stimulation, and transcranial direct current stimulation. More invasive potential interventions such as deep brain stimulation involve electrical stimulation of the brain through electrode implants (Temel *et al*, 2016).

Second, with respect to forensic practitioners' role as court-appointed experts, we probed their views on the possible uses of neuroimaging in assessing legal responsibility within court settings. Further developments in neuroimaging research may be used in criminal justice settings to inform forensic psychiatric and neurological expert reports (Witzel *et al*, 2008).

Currently, the use of structural or functional brain images in court is more widespread in US courts as compared to European courts and it is mostly limited to the sentencing phase to acquire sentence mitigation (Ginther, 2016; de Kogel and Westgeest, 2015; McSwiggan *et al*, 2017; Morse, 2016). Future usage of brain imaging in court settings may involve establishing the presence or absence of psychiatric or neurological disorders (Roskies *et al*, 2013) and scientifically assessing intentionality, degrees of legal responsibility, or recidivism risk (Aharoni *et al*, 2008).

Finally, with relation to their role in prevention and public protection, we asked them about their views concerning the possibilities and desirability of early detection and intervention based on biomarkers. Preliminary research is underway to determine which biomarkers – genetic, neurobiological, and physiological – might give accurate risk assessments of future violent and antisocial behaviour and which preventive interventions would be effective in reducing those risks (Gaudet *et al*, 2016; Glenn and Raine, 2014; Glenn *et al*, 2015; Liu, 2011; van Goozen and Fairchild, 2008; Rocque *et al*, 2012; Singh *et al*, 2013; Singh and Rose, 2009). Other uses of biomarkers that are being investigated are biological predictors of inpatient violence, length of stay, and reoffending (Aharoni *et al*, 2013; Sedgwick *et al*, 2016).

Methods

Sample and recruitment

We recruited 18 forensic practitioners (forensic psychiatrists, clinical psychologists, and therapists) in the Netherlands and in Belgium. Subjects were recruited via professional organisations and by snowballing, and were not incentivised. Our sample consists of seven females and 11 males, ranging in age from 32 to 68 years. At the time of the interviews, nine participants were employed in the Netherlands and nine participants were employed in Belgium.

We conducted eight interviews with forensic psychiatrists (FP) (at the time of the interview, one participant worked as a general psychiatrist, but had worked in forensic settings in the past). We conducted 10 interviews with clinical psychologists (CP) or therapists (T) (at the time of the interview, one participant – a therapist – was primarily involved in research and did not consult patients, but had done so in the past). Ten participants (five psychiatrists and five psychologists) are involved in scientific research, alongside their clinical or therapeutic work.

Qualitative interviews

Participants took part in an individual semi-structured interview lasting approximately 1 h. During one interview, two respondents were present and interviewed together. The interviews were held in Belgium and the Netherlands, and took place between July 2015 and July 2016. The interviews were conducted by JS, FF, and MS. JS attended 14 interviews, FF attended seven interviews, and MS attended one interview.

The interview schedule included open-ended questions about participants' expectations towards and normative views on the following: potential future options for treating aggression; potential usage of neuroimaging in determining legal responsibility within court settings; and the question as to whether insight into the neurobiological and biosocial predictors of criminal behaviour might broaden opportunities for early detection and prevention of children and adolescents who might be considered at risk of future violent or antisocial behaviour. As forensic psychiatrists and psychologists, and psychiatrists and psychologists in general, are trained to understand and treat human behaviour from a medical and/or healthcare perspective, and faced with the many variations that may exist between people, with respect to both non-deviant and deviant behaviour on a daily basis, we expected to receive highly nuanced and diverse responses to our questions.

In addition to the open-ended questions, the interview schedule contained a number of examples (prompts) to enable the interviewer to gain a more detailed answer. For example, regarding potential future options for treating aggression, we would add: "One might well look at interventions such as TMS, DBS, or potential new pharmacological interventions. Do you expect interventions such as these to find entrance in your professional practice?" In this paper, we report on our findings and discuss possible ethical implications.

Coding

All interviews were conducted in Dutch, audio-recorded, and transcribed verbatim. Interviews were coded in QSR NVivo version 10 using descriptive theme analysis (Bazeley and Jackson, 2013). Because our methodological orientation was content analysis, and our research was not hypothesis-driven but data-driven, we aimed at exploring the broad, varied perspectives and meanings that participants hold (Creswell, 2013; Tong *et al*, 2007).

All transcripts were independently read by all members of the research team (JS, FF, MS, SS) and discussed with the purpose of drafting a preliminary analytic framework. JS independently coded the transcripts by labelling sections and text units referring to one or multiple concepts relevant for the study purpose. An iterative approach was used in which new data that challenged the existing coding structure were used to revise the themes until no new themes emerged. Interpretative bias of data was avoided by means of investigator triangulation, which involved all researchers checking the codes for consistency. Two researchers (FF and MS) independently coded three transcripts and compared their coding and categorising with that of JS. Illustrative quotes that were included in the results section were translated by JS. All members of the research team checked the translations for accuracy.

Results

Aggression

Do forensic practitioners expect that effective biomedical interventions to lower aggression will be developed, and how do they morally view those potential interventions? A large majority of participants expect that novel interventions will be developed. At the same time, however, nearly all participants stress that violent and antisocial behaviour can have many different (kinds of) causes, that at present there is lack of fundamental knowledge, and that

no simple, mono-causal model of aggression is (and will be) available. In view of this complexity, several participants question the effectiveness of one single (biomedical) intervention and urge for an approach combining biomedical and psychosocial interventions instead. Forensic practitioners' moral views of potential biomedical interventions are quite diverse and range from outright rejection, to cautious embracement, and more positive and welcoming attitudes.

Complexity of aggression

Before offering an opinion on potential neurobiological and genetic interventions for treating aggression, nearly all participants discuss at length the considerable difficulty of formulating a correct and comprehensive model of aggression. Forensic psychiatrists particularly tend to emphasise the importance of accurate diagnosis, of understanding different types of aggression (e.g. recurring and constant, or incidental, premeditated or impulsive), and of unravelling possible associations with mental or personality disorders, intellectual disability, and addiction and substance abuse. This can be illustrated with the following quote from a participant:

> Apparently, with compulsive behaviours, behaviour regulation can be influenced on a fundamental level. With aggression, we need to ask, is it constant or incidental? Oftentimes, it is incidental and triggered in a specific situation. That is different from, for example, OCD, which is more or less permanent. (FP4)

Many participants emphasise the current absence of a comprehensive explanatory model of aggression. One example of a knowledge gap that is often mentioned is the lack of understanding of the relation between psychiatric disorders and (aggressive, deviant) behaviour.

> We know very little about the relationship, the causal link between disorders and behaviour. This applies to problems as we observe them and as we now classify them according to the DSM – let alone how that plays out physiologically. […] You can look at a brain, and you can say, 'well, maybe those neural pathways are less developed, or that lobe is a bit smaller or bigger' – but by saying that, you have not explained why someone is aggressive. Not everyone who has that brain-abnormality is aggressive. The reverse does not apply either. We are still very far from being able to intervene and remedy it [aggression]. (T1)
>
> If I try to understand how different factors interact, the only fair answer is that we do not know. We know a number of codetermining factors, but we have no idea how they relate to each other, how they might reinforce, stop, trigger other factors, set up a cascade or not. We do not understand why many people in spite of these factors continue to develop in a healthy and well-behaved way. (CP3)

Most participants (forensic psychiatrists as well as psychologists) discuss the ways in which societal norms and definitions of aggression differ and the ways in which aggression is often dependent on personal and social circumstances. Many participants stress that neither our understanding of aggression nor potential interventions to counter aggression should focus

exclusively on either individual or environmental factors, but that, instead, both should be taken into account.

> A general trend can be observed towards intervening at the biological or somatic level. We see this for example in sexual offenders, in a quite rigorous way. This entails a risk of taking a fairly one-sided approach. With aggression, it might be that treatment will develop in the same direction. Although I have yet to see if that would be possible as specifically as with sexual disorders. (FP6)

A number of participants identify barriers to the introduction of biomedical interventions, such as the need to build consensus and support among professionals with diverse disciplinary backgrounds, who work from within different paradigms. Some participants mention that, historically, research in forensic populations has not been a priority.

> Once you enter prison, you find yourself in a criminal justice context. Here, medicine stops, and research stops as well. That really struck me. It is an interesting, special pathology that you do not see in regular medicine. Yet hardly any research is conducted there. (FP2)

Aggression: Moral views

Several participants refer to the harmful side effects of many current (typically pharmacological) biomedical interventions and their negative impact on treatment adherence. Some participants express the hope that future biomedical interventions will have fewer side effects. Others, however, are concerned that interventions must be highly invasive in order to counter aggression effectively.

> I think to do this, for this to be really effective, I feel the interference with brain function needs to be so high impact, that things such as identity and personal performance would become radically standardised. (CP3)

Some participants express the concern that wider opportunities to intervene will instigate less tolerance towards deviant traits or towards acting out (both in society at large and in forensic contexts). They stress that deviant or seemingly unwanted traits (such as those associated with psychopathy) can be advantageous in some contexts, and that altering 'bad traits' or enhancing 'good traits' could have unforeseen and unwanted consequences (e.g. too much empathy).

Several participants question whether potential interventions may be mandatory (for example as a precondition for rehabilitation). Many stress the importance of voluntariness and proper informed consent procedures, even if – as a number of participants discussed – treatment in forensic contexts may often involve coercive offers. A number of participants speculate on how future biomedical interventions may offer options for patients who currently are considered treatment refractory, yet at the same time argue that invasive interventions should preferably (or only) be offered as a last resort.

> The more invasive and irreversible it is, the longer you should wait to consider it, I think. However, it need not be ruled out completely. (CP1)

Several participants prefer alternative, less invasive ways to limit aggressive behaviours and promote impulse control and self-regulation, e.g. cameras, gaming, apps, electronic monitoring, virtual reality training, etc.

Several participants discuss whether biomedical interventions would render the subject's role in treatment too passive. Some participants feel that passivity in this context is morally problematic in itself, for example because biomedical treatments tend not to consider the reasons why someone engaged in aggressive behaviour, or because they feel treatment should focus on enhancing a patient's capacity to manage herself or on fostering self-awareness and self-knowledge. Others are worried that passivity would reduce the treatment's long-term effectiveness, for example because they expect the aggression-reducing effects to last only as long as the intervention is given.

Neuroimaging in the courtroom

Will enhanced options for neuroimaging improve the identification of criminal responsibility? Expectations vary widely; some participants indicate that they indeed expect that developments in neuroimaging will be rapid, and that neuroimaging will be used more often in court settings, while others situate such options in the distant future. By and large, most participants were highly skeptical of its potential effectiveness and mentioned numerous moral concerns regarding its implementation.

Neuroimaging in the courtroom: Confrontation of legal and medical terminology

Also on this issue, many participants reflect on the conceptual framework before going into the expected use and moral desirability of using neuroimaging to assess legal responsibility. Several participants mention the difficulties associated with operationalising responsibility, which is essentially a legal and not a medical concept, and argue that legal concepts fall outside of their expertise as forensic practitioners. Some even indicate that they feel they should not say anything at all on this issue.

> The whole concept of legal responsibility is almost a philosophical concept. As psychiatrists, and behavioural experts in general, we are limited in what we can say about it. (FP6)

Some problematise the concept of legal responsibility itself and express a preference for a system in which forensic risk assessment instead of assessment of legal responsibility determines whether someone is referred to prison, treatment, or both.

Neuroimaging in the courtroom: Moral views

Many participants are concerned that imaging data will be misinterpreted and oversimplified. They refer to the difficulty of correctly interpreting neuroimaging results and the lack of

expertise of, for example, judges or juries. They talk about the power of images and the illusionary appearance of objectivity they might convey. They discuss the false sense of security neuroimaging might offer, and how this might negatively impact legal processes.

> At one point, the image starts to determine who someone is, well, yes almost determining who someone is. And therefore also, how far his responsibilities, to what extent he is responsible for his behaviour. (…) I even think it's a risky development, because it claims that it can classify people very precisely. And taking into account the ways things tend to go in the confrontation between behavioural experts and the judiciary, the behavioural expert suddenly pretends to hold the truth. And if you're not careful, the judiciary will go along with that. (FP6)

Some participants are concerned that the use of neuroimaging results would reinforce ideas of incorrigibility, of 'violent brains', 'born criminals', or 'born monsters' who differ fundamentally from normal people, thus underestimating plasticity and individual adaptability and undermining ideas of individual agency and responsibility.

Several participants indicate that they feel that presenting imaging data unequivocally would fulfil a societal demand, for example because judges welcome it or because it would make it easier for many people to tolerate and accept crime.

> This man said 'Show me a brain and I can tell you if he is a paedophile or not.' That is something society begs for, I think, a doctor who clearly indicates based on an image, 'This is a paedophile and he is dangerous, he's a predator, lock him up.' Or 'Remove that part of his brain, break his skull open.' That is something society would really welcome. If only it would be so simple and easy to address. I think this is a serious danger. In this regard, I feel more than a professional resistance; I think we should not go there. (CP4)

Early identification and prevention of violent and antisocial behaviour using biomarkers

Finally, we asked participants whether insight into neurobiological and biosocial predictors of violent and antisocial behaviour might broaden opportunities for early detection and prevention of children and adolescents who might be considered at risk of future violent or antisocial behaviour. All participants (except for one psychiatrist) indeed expected biomarkers to be integrated in preventive screening programs and even considered this a largely unstoppable development. At the same time, however, participants expressed a strong professional resistance, discussed the substantial implications of such programs, and mentioned a range of moral concerns.

Many participants stressed the importance of prevention rather than cure, of being able to prevent pathology, and of intervening before people become involved with the criminal justice system. Some expressed a particular interest in identifying extreme cases as early as possible.

> The earlier we can intervene, the better. Because we often see people with such difficult pasts and with histories of failing assistance. This is due to the person in question, but also due to us. We do too little, or we fail to persevere. Legal frameworks also provide

> us insufficient opportunities to intervene, measures such as involuntary commitment for example. (FP3)

Pessimism about or reluctance towards prospects of using biomarkers in early prevention and intervention programs sprang from the following main considerations: the low predictive value of biomarkers; the lack of feasibility of large and comprehensive screening programs; and moral concerns about labelling and stigmatisation.

Early identification and prevention of violent and antisocial behaviour using biomarkers: Feasibility of accurate prediction

Several participants stress difficulties associated with (or even the impossibility of) accurately predicting risk of future violent or antisocial behaviour. For example, they assert that hardly any direct, causal relations between physiological characteristics and future antisocial or criminal behaviour are established.

> It seems that a range of factors – that are also associated with each other – correlate with crime. I cannot see how you could intervene solely based on physiological characteristics. There are hardly any cases where such a one-on-one relation exists. (T1)
> Of course there is always the problem that there never is a one-on-one relation, and that all those factors that contribute to you going off track in such a way that you end up in civil commitment, are all, single-handedly, very prevalent. (CP6)
> Everyone is at risk for aggression. Because aggression is the most human thing there is. (CP5)

Some also mention the difficulty of determining the proper moment to intervene. They caution against intervening too early and note the problem of potential false positives and negatives.

Several participants draw a parallel with screening and prevention programs within general psychiatry, aimed at identifying people who are at a higher risk of experiencing psychoses, where a large group needs to be screened and monitored in order to identify the relatively small subgroup that is actually at risk and that could benefit from interventions. Participants contemplate the (cost-)effectiveness of such large and comprehensive programs and mention difficulties associated with correctly interpreting biomarkers and formulating appropriate selection and inclusion criteria. A few participants problematise underlying conceptions of crime, delinquency, antisocial behaviour, and violence.

> Delinquency has to do with transgressing norms, which are nowhere to be found in the brain but are defined by a social group. (CP3)

Early identification and prevention of violent and antisocial behaviour using biomarkers: Moral views

In addition to concerns about feasibility, many participants express moral concerns regarding early prevention and detection programs. They are worried that such programs

would be focused primarily at preventing future crime instead of helping children or relieving suffering, that such approaches would tend to be paternalistic and coercive in nature, and that they would target and single out individual children as 'risky children'. Many participants mention and strongly reject the likely stigmatising and discriminatory (and even self-fulfilling) effects of labelling – especially young children – as being at risk for future antisocial behaviour.

> If I need to choose between labelling and prevention, I would say that it is more important not to label, especially young people. Labelling is based solely on risk, and so little on opportunities and possibilities for positive development. (FP1)

Although many participants underline the importance of prevention in general, they see important ethical differences between prevention programs aimed at precluding impaired development of the child or individual in question and programs that focus on preventing crime.

> What you strive for, is helping children, when they are hindering themselves or others, to develop in a positive way. Once you identify a child as a potential offender, you are already treading on very thin ice. (FP6)

Some participants welcome biomedically informed prevention efforts, provided that they aim to relieve current and future suffering, aid development, and offer opportunities to develop a full life. Some participants speculate about biomarker research offering insights into underlying factors, how such research may offer new, more precise treatment options, and how it could be used as a source of information in treatment settings.

> What I find more interesting is whether it [e.g. skin conductance] may provide indications for doing something different than we had imagined by looking at behaviour alone. That could give some sort of insight; 'You have been tense for a couple of days.' And that this would help prevent escalation. I find that very interesting, that you can use it as a source of information, to gain insight. (FP8)

A number of participants prefer general awareness and education campaigns (for example about impulsiveness for all school-aged children) or (psycho) education aimed specifically at individuals at risk:

> I support everything that has to do with self-awareness and with being able to deal with those personal characteristics that increase the likelihood of undesirable outcomes. (CP3)

However, some participants worry that other, non-biological markers (such as social and environmental factors) will disappear from sight, which would negatively affect the therapeutic relationship.

> I hope that it won't become self-evident, that my job in several years will be reduced to being confronted with a blood level and to determine on that basis which treatment to initiate, and whether treatment should be outpatient or inpatient. I hope I will still be able to be in contact with people. (CP4)

Some participants situate speculation about biomedically informed early detection and prevention programs in the context of broader societal trends, such as increased focus on early prevention, higher societal risk aversion, and decreasing tolerance for deviance and abnormality.

> I think these issues are very topical, because much appears to be controllable. At many levels, not only with regard to people but also in business, we assume everything manageable. I don't believe such malleability exists – we are keeping this illusion alive, but it is a kind of fake truth. (FP5)

> Everyone wants us to do more prevention. Authorities are asking, what should we do with those children in the neighbourhoods? Which signals must we take seriously and which not? When should we scale up? That has nothing to do with innovative technology, but rather with how far we should go in actively tracking and detecting. (FP8)

> At that moment, we will have to ask what kind of society we want to live in. North Korea will have a different perspective than European countries. If you decide as a society that you prioritise zero-risk policy, where the collective rather than the individual is the starting point, then I can imagine that politics will embrace such policies. Yes, I find that prospect quite disturbing. (FP5)

Discussion

In this study, we interviewed forensic practitioners in the Netherlands and in Flanders, Belgium about their expectations and moral views regarding potential biomedical interventions to prevent, contain, or treat violent and antisocial behaviour, explicitly focusing not only on potential efficacy but on moral desirability as well. Little is known about forensic mental health practitioners' perceptions of potential biomedical interventions for forensic patients and offenders with mental health issues.

Overall, this study indicates that forensic practitioners expect novel biomedical interventions to find entry in their professional practice, either because they anticipate that rapid scientific developments will generate effective biomedical interventions, or, alternatively, because they observe a growing (societal, professional) demand for biomedical interventions (for example because of their perceived greater objectiveness and effectiveness as compared to non-biomedical interventions). This is a reason why, in our analyses, we have been careful to distinguish between four aspects: forensic practitioners' expectations that potential new biomedical interventions will become available; their expectations regarding the effectiveness of these potential interventions; whether they generally welcome biomedical interventions and hope new biomedical interventions will become available, or whether, on the contrary, they fundamentally ethically reject the introduction of potential future biomedical interventions in their professional practice.

Few forensic practitioners in our study seem to oppose biomedical interventions per se. Yet, when discussing their potential efficacy, most forensic practitioners strongly advocate

epistemic caution. Participants underline that mono-causal explanatory models are not available and point to the complex (non-direct/non-causal) relations between individual (neuro)biology, genetic susceptibilities, mental disorders, environment, SES, and violent and antisocial behaviour. They discuss difficulties associated with correctly interpreting neuroimaging results (see, for example, Rose and Abi-Rached, 2013) and warn that genetic susceptibility to violence (Pieri and Levitt, 2008) and predictions based on biomarkers lack individual predictive value (Starr, 2014).

Participants who in general welcome novel biomedical interventions anticipated or hoped for less severe side effects than those of current (mostly pharmacological) treatments. Moreover, they hoped that these interventions will provide insight into underlying causes of violent and antisocial behaviour as well as increased opportunities to tailor interventions to the individual in question (personalised medicine). Participants also expressed hope that such interventions might provide opportunities for increased self-awareness and self-regulation, and will make patients less dependent on contingent factors such as the particular care provider and the preferred form of (psychosocial) therapy.

Our study reveals a mixed picture with respect to forensic practitioners' moral concerns about potential biomedical treatments for aggression. Major skepticism and considerable moral concerns were expressed with regard to the use of neuroimaging in court. As to early detection and prevention using biomarkers, these were almost entirely rejected by our respondents.

By and large, participants seem to be aware of major ethical issues as they are being discussed in current ethical debates on potential biomedical interventions. These are concerns about reductionism and disregard for socio-political circumstances in case of novel treatment options for violent and antisocial behaviour (Goldberg, 2011), the difficulty of reaching consensus on the meaning and significance of neuroimaging in the courtroom (Aggarwal, 2009; Glannon, 2014), as well as major ethical concerns with respect to early detection and prevention of violent and antisocial behaviour such as labelling and stigmatisation, societal control, and undue focus on risk (compare Horstkötter *et al*, 2014a; Wolpe, 2013).

Regarding potential novel treatment options for violence and antisocial behaviour, several participants stressed the need to obtain informed consent when offering biomedical interventions. The legitimacy of coercion and of mandating biomedical interventions has recently been a topic of discussion in the ethical literature as well. Interventions involving coerced or semi-coerced drug and/or hormonal treatments that may involve very serious side effects and affect an individual's mental liberty are considered ethically problematic (Bublitz and Merkel, 2014; Focquaert, 2014). However, some philosophers have recently argued that an offender's mental liberty or 'freedom of thought' is potentially equally violated by forced incarceration practices as by forced biomedical interventions (e.g. Carter, 2016; Douglas, 2014; Petersen and Kragh, 2017). In our view, important differences exist between forcing a biomedical intervention upon an offender and depriving an offender of the right to free movement. Even though current incarceration practices are often ethically problematic, incarceration does not violate an offender's *mental* liberty in the same way forced neuro-interventions can violate it, because biomedical interventions are more likely to bypass our capacity to reflect upon the changes they bring about, and can overrule the ability to gradually endorse, reject, or object to the alterations of our self (Focquaert and Schermer, 2015; Focquaert, 2017).

Most direct biomedical interventions (e.g. pharmacological interventions, transcranial magnetic stimulation, transcranial direct current stimulation) exert temporary effects and are essentially reversible in nature. This means that the beneficial treatment effects (e.g. symptom reduction in case of aggressive thoughts and behaviour) only last as long as one takes the medication or gets the stimulation. Nevertheless, it is not unlikely that the long-term use of biomedical interventions can have irreversible effects on one's cognitive–emotional functioning, especially when the intervention is started at an early age [e.g. the use of Ritalin for attention deficit hyperactivity disorder (ADHD)]. Non-invasive, indirect biomedical interventions such as environmental enrichment and food supplements on the other hand supposedly have lasting, positive effects on children's brain development. Although more invasive interventions such as deep brain stimulation are considered to have the potential to permanently rewire the brain after long-term use as well [e.g. in case of obsessive compulsive disorder (OCD)], such findings have not been reported.

With respect to the use of neuroimaging data in court, participants in our study were particularly concerned about mis- and overinterpretation and potential detrimental effects on legal processes. Similar worries are voiced in a recent paper on the use of neuroscientific evidence in Canadian criminal proceedings (Chandler, 2016). For example, an experimental study by Aspinwall and colleagues showed that judges that are confronted with neuroimaging data tend to impose lower sentences and list more mitigating factors (Aspinwall *et al*, 2012). A recent empirical analysis examining the use of neurological and behavioural genetic evidence in US criminal law (between 2005 and 2012) reports that neurobiological data were most commonly used by criminal defence attorneys to mitigate responsibility and punishment (Farahany, 2016). At the same time however, this study showed that prosecutors have argued for higher sentences referring to 'hard-wired' incorrigibility or future dangerousness of perpetrators, confirming the idea that neuroimaging data can function as a double-edged sword (Chandler, 2016; Aspinwall *et al*, 2012).

A significant added value of our study is that it shows forensic practitioners to be aware and cautious of various misunderstandings and misrepresentations that might result from the specific dynamics of the forensic field. These misinterpretations may arise, first, from the ways in which scientific findings are translated to forensic psychiatric practice. Second, they may arise when forensic practitioners interact with other legal (judges, jurors, etc.) and political (e.g. Department of Health or Justice) professionals who operate in different institutional frameworks (law, medicine, politics), and who may lack the expertise to correctly interpret biomedical interventions or findings. Third and finally, in confrontation with wider society, forensic practitioners are concerned about how biomedical interventions will be perceived by the general public and the media (Berryessa *et al*, 2016). Of particular concern is the risk that biomarkers for future violent or antisocial behaviour will reinforce perceptions of children as at risk, or risky[1] before they have actually engaged in harmful behaviour, and the substantive negative effects of labelling and stigmatisation (Chhangur

1 "Two senses of risk are brought into alignment. The first is the desire to identify risky individuals – that is to say, those who will present a future risk to others – before the actual harm is committed. The second is the hope that one might be able to identify individuals at risk – those whose particular combination of biology and life history makes them themselves susceptible to some future condition – here personality disorder, impulsivity, aggressivity, or whatever, but more generally susceptibility for any psychiatric disorder" (Rose and Abi-Rached, 2013, p. 197).

et al, 2015; Horstkötter, 2015; Levitt and Pieri, 2009; Pieri and Levitt, 2008; Rocque *et al*, 2012; Wasserman, 2014).

Notably, a range of ethical concerns voiced by forensic practitioners in this study may not be exclusive to bio-interventions. Some participants even explicitly mentioned that many of their moral concerns apply to some non-biomedically informed interventions as well:

> I think dilemmas of this type apply equally to behavioural therapy for example. (FP8)

Likewise, in ethical analyses regarding early detection and prevention programs, the argument has been made that many (but not all) objections voiced against biomedical approaches apply to psychosocial approaches as well, and that therefore, from an ethical point of view, "it is more important to determine how to deal responsibly with possible risks of early detection and prevention than asking whether this is based on a social scientific, a psychological, a biological or a mixed approach" (Horstkötter *et al*, 2012, p. 295; Horstkötter *et al*, 2014a). On the other hand, our interviews suggest that forensic practitioners think that some issues may nevertheless be more relevant to bio-interventions (notably concerns about invasiveness, mental freedom, and irreversible or long-term side-effects).

In conclusion, forensic practitioners mostly appear to endorse and reason based on bio-psycho-social models of violent and antisocial behaviour. They stress that biomedical approaches will not (or should not) make current psychosocial approaches obsolete and that they should work in concert instead. This is consistent with current scientific literature in which there is a growing consensus that bio-psycho-social explanatory models of violent and antisocial behaviour are the most promising ones (Eichelberger and Barnes, 2015; Lee, 2015). Yet, our interviews show that forensic practitioners are also concerned about and acutely aware of the fact that the integration of neurobiological and behavioural genetic elements in explanatory models of violence and antisocial behaviour may be misinterpreted in various ways and by various actors, especially when implemented in the forensic field.

Limitations and Suggestions for Future Research

Because the study is qualitative and the sample size is limited, we cannot draw conclusions about the minor differences we observed between psychiatrists and psychologists in terms of their general openness towards potential biomedical interventions. Whereas the majority of forensic psychiatrists demonstrated a basic openness to these developments, we observed a more critical attitude among psychologists. Drawing a comparison between these groups was not a central study aim, as our focus was on the expectations and moral views regarding potential biomedical interventions of forensic practitioners generally. The differences we observed reflect and are consistent with the various disciplinary backgrounds of forensic practitioners, i.e. medicine in the case of forensic psychiatrists and clinical and social psychology and criminology in the case of forensic psychologists and therapists, as well as the slightly different institutional contexts they tend to work in. Future research might explicitly focus on comparing expectations and moral views of different forensic practitioners working in different institutional settings and in addition might take into

account differences with respect to institutional architectures of forensic care in, for example, European countries compared to the United States.

Acknowledgements

We would like to thank the forensic practitioners who graciously agreed to be interviewed. We are grateful to two anonymous reviewers for helpful comments on an earlier version of this article. This research is funded by The Netherlands Organization for Scientific Research (NWO) and the Scientific Research Foundation Flanders (FWO). The authors have no competing interests.

About the Authors

Jona Specker is a PhD student at Erasmus MC, Department of Medical Ethics and Philosophy, the Netherlands. Her research focuses on the ethical desirability of moral bioenhancement.

Farah Focquaert is a Postdoctoral Researcher at the Bioethics Institute Ghent at Ghent University. She lectures on bioethics, public health ethics, and philosophy. Her research focuses on moral enhancement, neuroethics, and the philosophy of free will.

Sigrid Sterckx is Professor of Ethics and Political Philosophy at Ghent University. She lectures courses on theoretical and applied ethics as well as social and political philosophy. Her research focuses inter alia on moral enhancement, with particular attention to neuro-interventions in offenders.

Maartje H. N. Schermer is Professor of Philosophy of Medicine at Erasmus MC, Department of Medical Ethics and Philosophy, the Netherlands. She teaches medical ethics, bioethics, and philosophy of medicine. Her research interests include human enhancement, neuroethics, and predictive and preventive medicine.

References

Aggarwal, N.K. (2009) Neuroimaging, culture, and forensic psychiatry. *Journal of the American Academy of Psychiatry and the Law* 37: 239–244.

Aharoni, E., Funk, C., Sinnott-Armstrong, W. and Gazzaniga, M. (2008) Can neurological evidence help courts assess criminal responsibility? Lessons from law and neuroscience. *Annals of the New York Academy of Sciences* 1124: 145–160.

Aharoni, E., Vincent, G.M., Harenski, C.L., Calhoun, V.D., Sinnott-Armstrong, W., Gazzaniga, M.S. and Kiehl, K.A. (2013) Neuroprediction of future rearrest. *Proceedings of the National Academy of Sciences USA* 110: 6223–6228.

Asherson, P. and Cormand, B. (2016) The genetics of aggression: Where are we now? *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics* 171: 559–561.

Aspinwall, L.G., Brown, T.R. and Tabery, J. (2012) The double-edged sword: Does biomechanism increase or decrease judges' sentencing of psychopaths? *Science* 337: 846–849.

Bazeley, P. and Jackson, K. (2013) *Qualitative Data Analysis with NVivo*. London: Sage Publications Limited.

Berryessa, C.M., Chandler, J.A. and Reiner, P.B. (2016) Public attitudes toward legally coerced biological treatments of criminals. *Journal of Law and the Biosciences* 3: 447–467.

Bublitz, J.C. and Merkel, R. (2014) Crimes against minds: On mental manipulations, harms and a human right to mental self-determination. *Criminal Law and Philosophy* 8: 51–77.

Campbell, E. and Ross, L. (2004) Attitudes of healthcare professionals and parents regarding genetic testing for violent traits in childhood. *Journal of Medical Ethics* 30: 580–586.

Carter, S. (2016) Could moral enhancement interventions be medically indicated? *Health Care Analysis*. doi:10.1007/s10728-016-0320-8.

Chandler, J.A. (2016) The use of neuroscientific evidence in Canadian criminal proceedings. *Journal of Law and the Biosciences* 2: 550–579.

Chhangur, R.R., Weeland, J., Matthys, W. and Overbeek, G. (2015) Gene by environment research to prevent externalizing problem behavior: Ethical questions raised from a public healthcare perspective. *Public Health Ethics* 8: 295–304.

Creswell, J.W. (2013) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks: Sage Publications, Inc.

de Kogel, C.H. and Westgeest, E.J.M.C. (2015) Neuroscientific and behavioral genetic information in criminal cases in The Netherlands. *Journal of Law and the Biosciences* 2: 580–605.

de Ridder, D., Langguth, B., Plazier, M. and Menovsky, T. (2009) Moral dysfunction: Theoretical model and potential neurosurgical treatments. In: Verplaetse, J., Schrijver, J., Vanneste, S. and Braeckman, J. (eds.) *The Moral Brain: Essays on the Evolutionary and Neuroscientific Aspects of Morality*. Dordrecht: Springer Netherlands.

Douglas, T. (2014) Criminal rehabilitation through medical intervention: Moral liability and the right to bodily integrity. *The Journal of Ethics* 18: 101–122.

Eichelberger, R. and Barnes, J.C. (2015) Biosocial criminology. In: Jennings, W.G. (ed.) *The Encyclopedia of Crime and Punishment*. Hoboken: Wiley.

Farahany, N.A. (2016) Neuroscience and behavioral genetics in us criminal law: An empirical analysis. *Journal of Law and the Biosciences* 2: 485–509.

Focquaert, F. (2014) Mandatory neurotechnological treatment: Ethical issues. *Theoretical Medicine and Bioethics* 35: 59–72.

Focquaert, F. (2017) On the impossibility of justifying the moral responsibility system. *Syndicate*. https://syndicate.network/symposia/philosophy/the-stubborn-system-of-moral-responsibility/.

Focquaert, F. and Schermer, M.H.N. (2015) Moral enhancement: Do means matter morally? *Neuroethics* 8: 139–151.

Fozdar, M.A. (2016) The relevance of modern neuroscience to forensic psychiatry practice. *Journal of the American Academy of Psychiatry and the Law* 44: 145–150.

Gaudet, L.M., Kerkmans, J.P., Anderson, N.E. and Kiehl, K.A. (2016) Can neuroscience help predict future antisocial behavior? *Fordham Law Review* 85: 503–531.

Ginther, M. (2016) Neuroscience or neurospeculation? Peer commentary on four articles examining the prevalence of neuroscience in criminal cases around the world. *Journal of Law and the Biosciences* 3: 324–329.

Glannon, W. (2014) The limitations and potential of neuroimaging in the criminal law. *The Journal of Ethics* 18: 153–170.

Glenn, A.L., Focquaert, F. and Raine, A. (2015). Prediction of antisocial behavior. In: Clausen, J. and Levy, N. (eds.) *Handbook of Neuroethics*. New York: Springer.

Glenn, A. L. and Raine, A. (2014) Neurocriminology: Implications for the punishment, prediction and prevention of criminal behaviour. *Nature Reviews Neuroscience* 15: 54–63.

Goldberg, D.S. (2011) Against reductionism in law & neuroscience. *Houston Journal of Health Law & Policy* 11: 321–346.

Gurnani, T., Ivanov, I. and Newcorn, J.H. (2016) Pharmacotherapy of aggression in child and adolescent psychiatric disorders. *Journal of Child and Adolescent Psychopharmacology* 26: 65–73.

Horstkötter, D. (2015) Forensic screening and prevention in children and adolescents: Public health ethical aspects. *Public Health Ethics* 8: 266–269.

Horstkötter, D., Berghmans, R., De Ruiter, C., Krumeich, A. and de Wert, G. (2012) "We are also normal humans, you know?" Views and attitudes of juvenile delinquents on antisocial behavior, neurobiology and prevention. *International Journal of Law and Psychiatry* 35: 289–297.

Horstkötter, D., Berghmans, R. and de Wert, G. (2014a) Early prevention of antisocial behavior (ASB): A comparative ethical analysis of psychosocial and biomedical approaches. *BioSocieties* 9: 60–83.

Horstkötter, D., Berghmans, R., Feron, F. and De Wert, G. (2014b) "One can always say no." Enriching the bioethical debate on antisocial behaviour, neurobiology and prevention: Views of juvenile delinquents. *Bioethics* 28: 225–234.

Hübner, D. and White, L. (2016) Neurosurgery for psychopaths? An ethical analysis. *AJOB Neuroscience* 7: 140–149.

Lee, B.X. (2015) Causes and cures II: The biology of violence. *Aggression and Violent Behavior* 25(Part B): 204–209.

Levitt, M. and Pieri, E. (2009) "It could just be an additional test couldn't it?" Genetic testing for susceptibility to aggression and violence. *New Genetics and Society* 28: 189–200.

Liu, J. (2011) Early health risk factors for violence: Conceptualization, evidence, and implications. *Aggression and Violent Behavior* 16: 63–73.

McSwiggan, S., Elger, B. and Appelbaum, P.S. (2017) The forensic use of behavioral genetics in criminal proceedings: Case of the MAOA-L genotype. *International Journal of Law and Psychiatry* 50: 17–23.

Morse, S.J. (2016) Actions speak louder than images: The use of neuroscientific evidence in criminal cases. *Journal of Law and the Biosciences* 3: 336–342.

Munthe, C. and Radovic, S. (2015) The return of Lombroso? Ethical aspects of (visions of) preventive forensic screening. *Public Health Ethics* 8: 270–283.

Petersen, T.S. and Kragh, K. (2017) Should violent offenders be forced to undergo neurotechnological treatment? A critical discussion of the 'freedom of thought' objection. *Journal of Medical Ethics* 43: 30–34.

Pieri, E. and Levitt, M. (2008) Risky individuals and the politics of genetic research into aggressiveness and violence. *Bioethics* 22: 509–518.

Pustilnik, A.C. (2009) Violence on the brain: A critique of neuroscience in criminal law. *Wake Forest Law Review* 44: 183–238.

Raine, A. (2013) *The Anatomy of Violence: The Biological Roots of Crime*. New York, NY: Random House LLC.

Rocque, M., Welsh, B.C. and Raine, A. (2012) Biosocial criminology and modern crime prevention. *Journal of Criminal Justice* 40: 306–312.

Rose, N. (2000) The biology of culpability: Pathological identity and crime control in a biological culture. *Theoretical Criminology* 4: 5–34.

Rose, N.S. and Abi-Rached, J.M. (2013) *Neuro: The New Brain Sciences and the Management of the Mind*. Princeton, NJ: Princeton University Press.

Roskies, A.L., Schweitzer, N.J. and Saks, M.J. (2013) Neuroimages in court: Less biasing than feared. *Trends in Cognitive Sciences* 17: 99–101.

Sedgwick, O., Young, S., Das, M. and Kumari, V. (2016) Objective predictors of outcome in forensic mental health services-a systematic review. *CNS Spectrums* 21: 430–444.

Singh, I. and Rose, N. (2009) Biomarkers in psychiatry. *Nature* 460: 202–207.

Singh, I., Sinnott-Armstrong, W.P. and Savulecu, J. (eds.) (2013) Bioprediction, biomarkers, and bad behavior: Scientific, legal, and ethical challenges. New York, NY: Oxford University Press.

Starr, S.B. (2014) Evidence-based sentencing and the scientific rationalization of discrimination. *Stanford Law Review* 66: 803–872.

Temel, Y., Hescham, S., Melse, M. and Visser-Vandewalle, V. (2016) Deep brain stimulation: Emerging indications. In: Hamani, C., Holtzheimer, P., Lozano, A.M. and Mayberg, H. (eds.) *Neuromodulation in Psychiatry*. Hoboken: Wiley.

Tong, A., Sainsbury, P. and Craig, J. (2007) Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care* 19: 349–357.

van der Gronde, T., Kempes, M., van El, C., Rinne, T. and Pieters, T. (2014) Neurobiological correlates in forensic assessment: A systematic review. *PLoS ONE* 9: e110672.

van Goozen, S.H.M. and Fairchild, G. (2008) How can the study of biological processes help design new interventions for children with severe antisocial behavior? *Development and Psychopathology* 20: 941–973.

Wasserman, D. (2014) Ethical and policy issues in genetic prediction of violence: Implications for clinicians. *Current Genetic Medicine Reports* 2: 216–222.

Witzel, J., Walter, M., Bogerts, B. and Northoff, G. (2008) Neurophilosophical perspectives of neuroimaging in forensic psychiatry—giving way to a paradigm shift? *Behavioral Sciences and the Law* 26: 113–130.

Wolpe, P.R. (2013) Rethinking the implications of discovering biomarkers for biologically based criminality. In: Singh, I., Sinnott-Armstrong, W.P. and Savulescu, J. (eds.) *Bioprediction, Biomarkers, and Bad Behavior: Scientific, Legal, and Ethical Challenges*. Oxford: Oxford University Press.